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NEWSLETTER OF THE LONDON CHAPTER,
ONTARIO ARCHAEOLOGICAL SOCIETY

LONDON CHAPTER
OAS

January, 1988

88-1

CURRENT ARCHAEOLOGICAL RESEARCH IN THE WESTERN LAKE ERIE BASIN

Dr. David Stothers
University of Toledo

This month's speaker comes from the exotic land of Toledo, Ohio. David Stothers has worked on the prehistoric and historic archaeology of the western Lake Erie basin for over the past ten years, and has contributed much to our understanding of the region. David's presentations are always entertaining and filled with the most up to date information on the northwest Ohio, southeast Michigan, southwest Ontario archaeological region - home of the Western Basin cultural group. So come on out. Meeting time is 8PM, Thursday, February, 11th at the Museum of Indian Archaeology.

NOTE: Because of our special guest speaker, our member's night presentations have been re-scheduled for April 14th.

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Executive

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EXECUTIVE REPORT

The 1988 Executive has now met twice, and the new members are getting used to the system. Few events are currently happening, so the Executive is spending most of its time keeping up with the day-to-day business of administration. Treasurer George Connoy reports our accounts are around $10,000. The Executive is thus planning to put a portion of this into a term deposit for a year. We certainly would like to see the Chapter earn the most it can from its funds! Occasional Publication Series editor Neal Ferris reports that close to half the chapters for our Prehistory of Southern Ontario volume have been submitted to volume editor Chris Ellis. More chapters should arrive shortly. In March Neal and Chris will have to meet and "encourage" those remaining contributors with submissions outstanding to buckle down and produce...or else! There is a risk of losing access to the word processing and printing facilities at the University of Waterloo by August 1st, which means by that date we must have a final master copy, ready to go to the printers. In light of the time and money the Chapter has already invested in this project, we cannot afford to jeapordize it by missing deadlines.

The Executive is also examining ways of cutting operating costs. Flushed with the financial success of the last two years, the Chapter has been financially extravagant with its recent various projects and events. KEWA in particular has become an expensive effort, due to the lack of a reliable photocopier, and a lack of assistance in producing the newsletter. However, it is clear that KEWA is the main reason for memberships and subscriptions to this Chapter. Consequently, the Executive is exploring ways to limit operating expenses related to the newsletter (leasing a reliable photocopier, soliciting more members for the newsletter committee, etc.), rather than reducing the quality of KEWA. Membership response to Chapter social events, on the other hand, has been weak over the last couple of years, despite increased spending for these events. Thus the Executive will attempt to reduce costs by limiting funds for such activities. Your views and suggestions of how to improve the economic and administrative life of this Chapter are strongly encouraged. It is difficult to make decisions which shape the structure of our Chapter without feedback from the membership.

Finally, the Executive would like to remind those members and subscribers who have yet to pay that your 1988 fees are due now. In order to avoid being taken off our mailing list, please send them in today. Thanks!

* * SUMMER 1988 EMPLOYMENT OPPORTUNITIES: * *

1. Looking for work this summer? Looking for an opportunity to gain valuable field experience in archaeology? Would you like to be responsible for more than moving backdirt and shaking a screen? Don't you wish you'd be given the chance to work with site collections and learn how to analyse materials? Well here is your chance! The **London Archaeological Office of the Ministry of Culture and Communications** will be hiring a crew under the Summer Experience '88 Student Employment program. Applicants must be between the age of 15 to 25, willing to work in the London area, and either have experience in archaeology, or be enthusiastic and want a chance to gain some experience. If you are interested, go down to your nearest Canada Employment Centre and fill out a job application for Summer Experience '88 Project #0703, London. Only individuals registered with their local employment centre are eligible.

For Information Contact: Neal Ferris, Ministry of Culture and Communications
55 Centre Street, London Ontario
N6J 1T4 (519) 433-8401.

2. 1988 Employment: Students interested in seasonal contract employment on

archaeological resource assessment and excavation projects in Ontario are invited to submit their resumes along with a brief statement of career goals to: Personnel Manager; Mayer, Pihl, Poulton and Associates Incorporated, 134 Commissioner's Road West, London Ontario, N6J 1X8 (519) 668-2400. All replies will be answered promptly.

* * *

The Museum of Indian Archaeology Announces The Opening of a New Exhibit:

SKYWALKERS: A HISTORY OF INDIAN IRONWORKERS
January 24 - May 1, 1988

On loan from the Woodland Indian Cultural Educational Centre, Brantford Ontario

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McMASTER ANNUAL SYMPOSIUM

"Current Archaeological Research in the Province of Ontario"
Saturday, February 13, 1988 - 9:00 AM to 5:00 PM
Kenneth Taylor Hall, Room B135
Registration $8.00

Featuring: Various Speakers belonging to the Ontario Council of Archaeologists, Bill Fitzgerald, Peter Timmins.....and much more.....

And for our more northerly members,

Archaeology of the Lake Superior Basin and Upper Mid-Continent 1988 Workshop
March 25 and 26th

This informal workshop will feature topics on current research, artifact identification and problems relating to Sandy Lake ceramics. The key word to this workshop is informal, and it is open to both professional and avocational archaeologists.

For more information contact: Grace Rajnovich, Staff Archaeologist
Heritage Branch, M.C.C.
227 Second Street South, 2nd Floor
Box 2880
Kenora, Ontario
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EDITOR'S NOTE

This month's solo effort comes from the keyboard of Bill Fitzgerald (London Chapter member - when he remembers to pay his dues!). Bill's main research interests lie firmly in Prehistoric and Historic Neutral archaeology, as well as the causes and effects of 17th Century trade and culture change in the Great Lakes. Bill is known for his writing style, his willingness to defend a point of view, and his handle on diverse sources of data related to Native-European trade, all of which are well illustrated in the following article. Enjoy.

SOME PRELIMINARY THOUGHTS ON STYLISTIC CHANGES TO 16th & 17th CENTURY COPPER ALLOY KETTLES AND IRON AXES

William Fitzgerald

Introduction

With the realization of the temporal and cultural sensitivity of the humble glass trade bead has come a chronological saviour that should lead to a better understanding of the economic and social events of the tumultuous 16th and 17th centuries. There seems to be an unfortunate trend to ignore the temporal precision that has been provided by glass beads, and consequently there have been a number of controversial areas of research which would be seen in a totally different light if there was a firmer grasp of chronology and reality. Unfortunately, there has been a tendency to reconstruct culture without first establishing chronological control.

Glass beads have provided a temporal framework from which stylistic changes in other, less frequently recovered artifact classes can be identified. Implementing a slightly modified version of the glass bead sequence pioneered by Ian Kenyon (1969), I would like to present trends that would seem to be apparent in two of the more notable European inrtroductions of the 16th and 17th centuries: the copper alloy kettle and the iron axe. In combination with the distinctive glass bead assemblages it will become evident that there were, as would be expected, constellations of artifact types which might be considered as characteristic of particular European suppliers. Those associations will not be presented here, I simply hope to illustrate the ease with which artifact histories can be reconstructed once there is a reliable chronology to work with.

Copper Alloy Kettles

While kettles from Glass Bead Period 1 (GBP1) sites exhibit some variability, they are generally homogeneous and distinctive in comparison to kettle varieties from later sites. The dramatic shift in the style of kettles seems to parallel the increased use of lower-priced brasses immediately after the end of GBP1.

By definition, pure coppers contain a minimum of 99.3% copper. The addition of other elements in various amounts and combinations produces a variety of alloys with different properties and potential uses. Generally the alloys tend to be harder, less malleable and less corrodible than true coppers. The particular value of coppers are that they possess almost unlimited capacities for being cold-worked while the alloys tend to be harder and more brittle as the copper content decreases. Perhaps this tensile property is reflected in the abundance of Native manufactured ornamental goods fashioned from metal that scratches reddish-orange -- a characteristic of copper and high copper content alloys. With decreasing copper content the alloys scratch yellow. Recent spectroscopic analyses indicate that a copper alloy that scratches reddish-orange is pure copper or an alloy with greater than 98% copper. In this study the dichotomy between "reddish-orange" and "yellow" can be confidently correlated with "copper" and "brass" respectively. What I hope to demonstrate is that there is a temporal shift in the predominance of high copper content alloys to lower priced brasses, and that this was a consequence of intentional commercial considerations developing out of the newly established fur trade.

As mentioned previously, true coppers are at least 99.3% pure. High copper alloys (96.0 - 99.3% copper) contain cadmium, beryllium, chromium or iron to give greater strength than copper. Brasses (an alloy of copper and zinc) can consist of anywhere from 61.4 - 97.3% copper with the remainder being zinc. Brasses with between 10 - 20% zinc and 80 - 90% copper are gold in colour and tend to be used primarily for ornamental purposes, while brasses consisting of 40 - 60% zinc and 40 - 60% copper are more yellow in colour and tend to be difficult to cold-work. Furthermore, in acidic water this brass combination tends to corrode. Heavily encrusted artifacts found on sites are likely to be one of these high zinc brasses.

Other major brasses include leaded brasses and tin brasses. Leaded brasses contain 32 - 39% zinc and 1 - 3% lead added to copper. While the inclusion of lead improves the ability to cut the material, lead does not mix well with copper and consequently reduces its strength and durability. Tin brasses are marked by a .5 - 2% addition of tin to the copper and zinc mixture. Tin adds tensile strength and corrosion resistence, and consequently this alloy can be cold-worked.

While brasses are used in application where some characteristic of copper is desired to be improved, a major reason brasses tend to be utilized is that they can be produced at lower costs (Wilkins and Bunn 1943: 27). During the 18th century, of kettles made from tin, copper, and brass, the latter type of kettle was considered the most inexpensive (Stone 1974). The rudimentary, but generally effective scratch test on kettle fragments recovered from sites, has revealed a temporal trend toward the extensive utilization of brasses, indicating a decrease in the inclusion of copper (Table 1). This presumably was a cost-saving development that is mirrored in the variety of kettle imported after GBP1. As was the case with glass beads, once the French developed a domestic industrial base during the reign of Henry IV (Nef 1964) to produce goods which could be used in the fur trade, there was a reduced need to import quality goods from other European manufacturing centres. A wide range of less expensive and inferior quality goods appear to flood the post-1600 market.

TABLE 1. Chronological Trends in the Presence of Copper and Brass.

GBP	Site	Sample Size	Copper %	Brass %	Overall GBP ratio
1	Snider	39	100	0	
	Fonger	34	76	24	
	Kleinburg	12	75	25	
	Benson	11	91	9	
	Hopps	10	90	10	
	Green Lake	7	71	29	
	Northport	4	100	0	
	Goodyear	3	67	33	87:13
2	Warminster	542	25	75	
	Christianson	146	63	37	
	Bidmead	88	9	91	
	Graham-Rogers	35	63	37	32:68
3	Ossossane II	194	18	82	
	Robitaille	58	17	83	
	Hood	22	4	96	17:83
	TOTAL	1205			

Glass Bead Period 1 Kettles

The most notable impression about kettles recovered from sites of this era is the amount of work that would have gone into this elaborate variety of kettle (Figures 1-7). If the number of kettles, and indirectly the amount of non-ferrous metal scrap, is any indication, the quantity traded to Natives was not that great. Quite probably the cost to the French to manufacture or import this style of kettle was prohibitive.

Material

Of the sixteen kettles and two pails of this distinctive style that have been examined, all but two are manufactured from a copper alloy that scratches "reddish-orange", indicating a very high copper content. The other two scratched "yellow", indicating that they were an alloy with a considerably lower content of copper (Table 2). This style of kettle was fabricated from high grade coppers which would have been more expensive than lower content copper alloys. Also, the metal of these kettles tended to be thicker (>1mm) than subsequent varieties.

TABLE 2. Iron Banded (GBP1) Kettles.

Site	Ethnic Group	Material	Maximum Diameter* (mm)	Maximum Height (mm)	Estimated Volume** (l)
Northport	Micmac	copper	460	220	28
		copper	395	220	19
		copper	330	250	15
		copper	245	135	5
Hopps	Micmac	copper	670	375	105
		copper	650	-	-
		copper	615	360	84
		copper	585	305	61
		copper	520	305	48
		copper	515	265	40
		brass	480	300	40
		copper	-	-	-
		copper	-	-	-
		copper	-	-	-
Gaetan	Neutral	copper	350	260	17
		copper	-	240	-
		brass	240	80	3
Grimsby	Neutral	copper	715	290	82

* diameter included rim
** V=pie x r-squared x h

Construction Technique and Kettle Shape

Since high copper content alloys are easily cold-worked, all of these specimens were likely formed by the battery method. Evidence for this is the consistent ball-peening pattern which starts at the centre of the base of the kettle, and radiates in a spiral towards the basal edge. The pattern proceeds in horizontal parallel rows up the side of the kettle. The regularity and compression of the peening suggests superior craftmanship, especially when compared to the randomness evidenced on later kettles.

Generally, the bases of these kettles are slightly convex. The largest kettle from Northport exhibited a 35mm difference between the depth at the edge and at the centre of the kettle. The smaller Northport kettle and the Gaetan basin possessed flatter bottoms.

All kettles had outward-sloping sides. The degree of outflaring varied: the largest Northport kettle expanded by 20mm over 220mm of height, while the Grimsby kettle

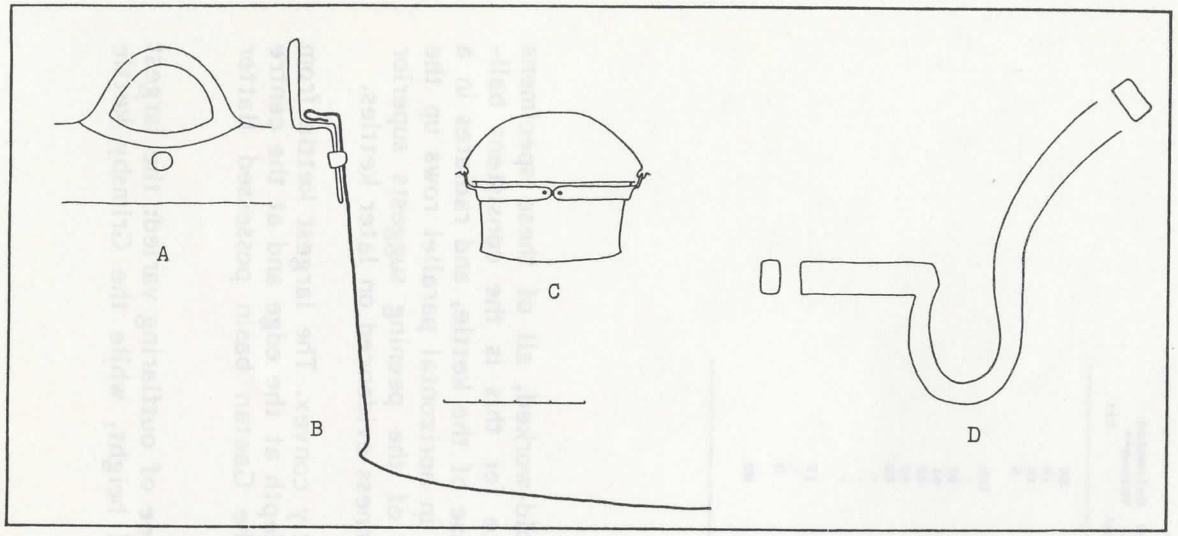

Figure 1. Micmac GBP1 Northport Cemetery Kettle (No. 1).

A. Iron band and handle attachment
B. Kettle cross-section
C. Kettle configuration
D. Handle end

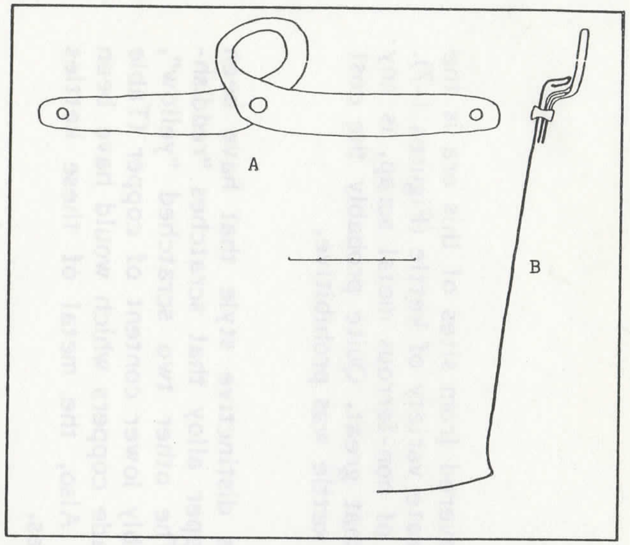

Figure 3. Micmac GBP1 Northport Cemetery Kettle (No. 3).

A. Copper support band and handle attachment
B. Kettle cross-section

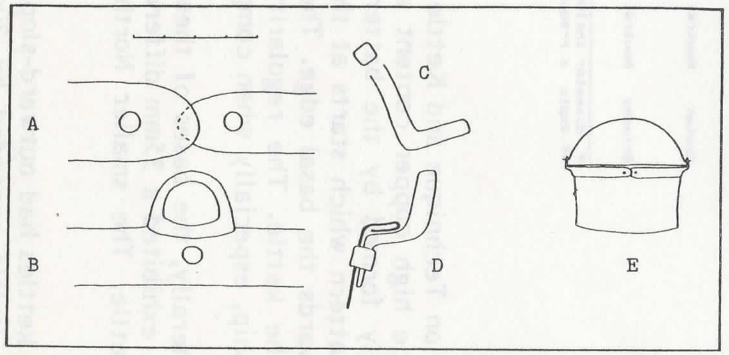

Figure 2. Micmac GBP1 Northport Cemetery Kettle (no.2).

A. Overlapping of iron support bands
B. Iron band and handle attachment
C. Handle end
D. Cross-section of upper portion of kettle
E. Kettle configuration

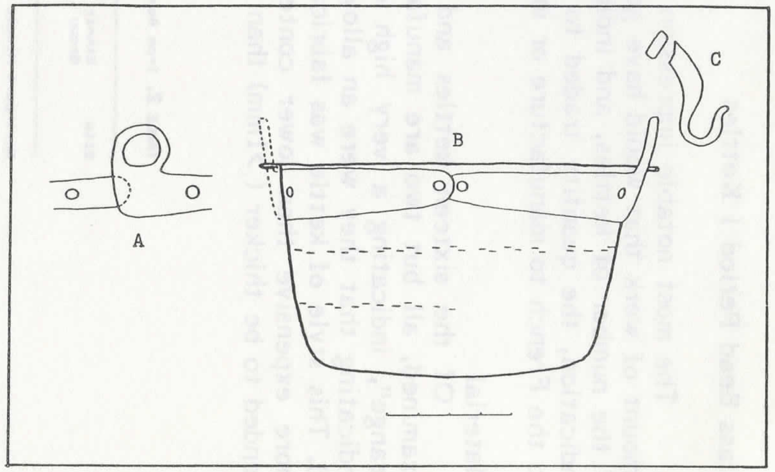

Figure 4. Micmac GBP1 Northport Cemetery Kettle (No. 4).

A. Iron support band and handle attachment
B. Kettle configuration
C. Handle end

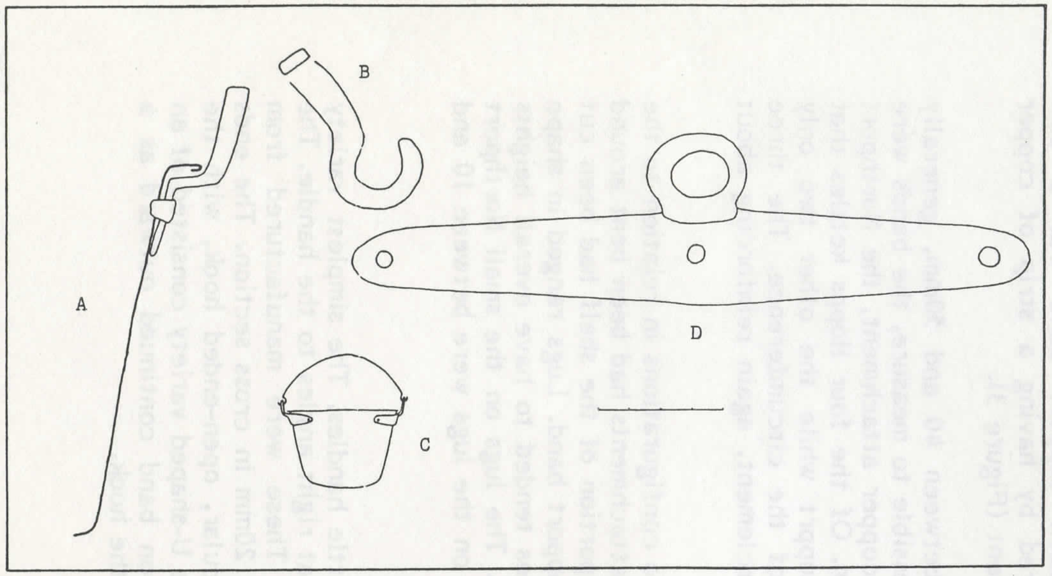

Figure 5. Neutral GBP1 Gaetan Cemetery Kettle (No. 1).

A. Kettle cross-section
B. Handle end
C. Kettle configuration
D. Iron band and handle attachment

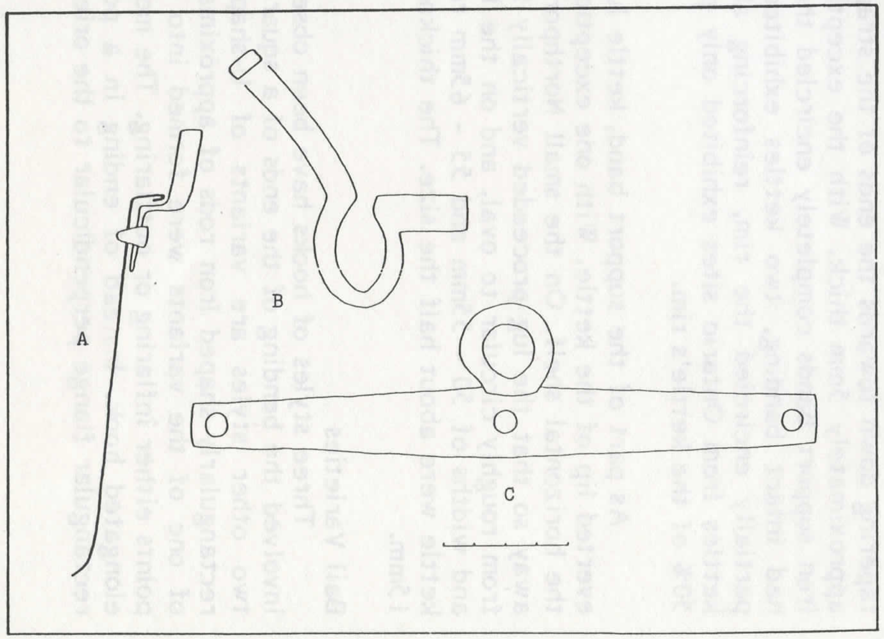

Figure 6. Neutral GBP1 Gaetan Cemetery Kettle (No. 2)

A. Kettle cross-section
B. Handle end
C. Iron band and handle attachment

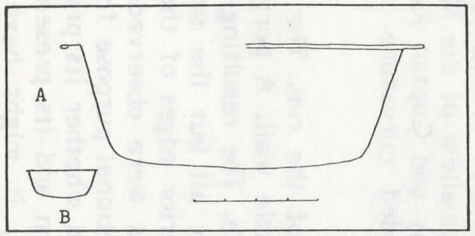

Figure 7. Neutral GBP1 Gaetan Cemetery Basin.

A. Basin cross-section
B. Basin configuration

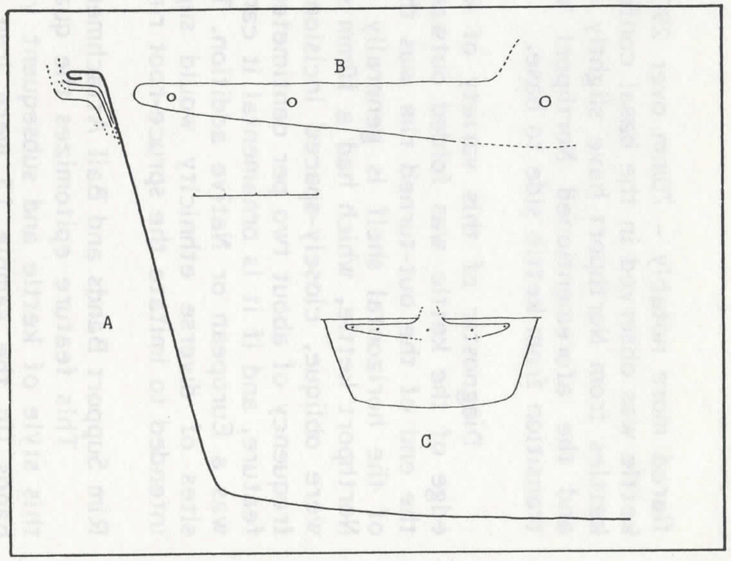

Figure 8. Neutral Grimsby Cemetery (GBP2 Grave 11) Kettle.

A. Kettle cross-section
B. Iron support band and handle attachment
C. Kettle configuration

flared more notably - 70mm over 290mm. The most notable difference in this style of kettle was observed in the basal configuration. While all but the smallest of the Micmac kettles from Northport have slightly outflaring bases, the Grimsby and Gaetan Kettles, and the aforementioned Northport specimen, possessed a rounded curvature in the transition from kettle side to base.

Diagnostic of this variety of kettle is the configuration of the rim. The upper edge of the kettle was folded outward, perpendicular to the kettle wall. A portion of the end of the out-turned rim was then tightly folded underneath. The resulting width of the horizontal shelf is generally consistent (17 to 22mm) for all but the smallest Northport kettle, which had a 10mm shelf width. Around the interior edges of the rims were oblique, closely-spaced incisions. generally, these incisions were observed at a frequency of about two per centimeter. There is no apparent functional purpose for this feature, and if it is ornamental it cannot be definitely determined whether its presence was a European or Native addition. The regularity of the pattern and its presence on sites of diverse ethnicity would suggest the former; however, it might have been intended to imitate the spruce-root rim lashing on birchbark bowls.

Rim Support Bands and Bail Attachment

This feature epitomizes the qualitative and presumable cost differences between this style of kettle and subsequent varieties. To strengthen the rim of the kettle two bands (in the sample 15 were iron and 2 were copper) were riveted to the kettle beneath the horizontal shelf. Incorporated into each support band was a bail attachment. The copper Northport attachment differed by having a strip of copper looped by hammering in order to form the bail attachment (Figure 3).

The maximum width of the iron bands were between 40 and 50mm, generally tapering down towards the ends of the straps. When possible to measure, the bands were approximately 5mm thick. With the exception of the copper attachment, the Northport iron support bands completely encircled the kettle rim. Of the four Hopps kettles that had intact banding, two kettles exhibited similar supprt while the other two only partially encircled the rim, reinforcing about 50% of the circumference. The three kettles from Ontario sites exhibited only partial encirclement, again reinforcing about 50% of the kettle's rim.

As part of the support band, kettle lugs took two configurations in relation to the everted lip of the kettle. With one exception, all bail attachments had been bent around the horizontal shelf. On the small Northport kettle a portion of the shelf had been cut away so that the lug proceeded vertically from the support band. Lugs ranged in shape from roughly circular to oval, and on the larger kettles tended to have overall heights and widths of 50 - 55mm and 55 - 65mm respectively. The lugs on the small Northport kettle were about half the size. The thickness of iron on the lugs were between 10 and 15mm.

Bail Varieties

Three styles of hooks have been observed on kettle handles. The simplest variety involved the bending of the ends of a square iron rod at right angles to the handle. The two other styles are variants of U-shaped hooks. These were manufactured from rectangularly-shaped iron rods of approximately 10 by 20mm in cross section. The ends of one of the variants were formed into a near circular, open-ended hook, with the points either inflaring or outflaring. The more intricate U-shaped variety consisted of an elongated hook. Instead of ending in a point, the iron band continued outward as a rectangular flange perpendicular to the orientation of the hook.

Summary

The manufacturing extravagances exhibited in all aspects of these distinctive kettles -- high copper content, intricate cold-working technique, elaborate rim and interior decoration, iron band rim support and bail attachment, ornate handles -- would seem incongruous within an economic situation that was attempting to maximize returns from the fur trade. The intricacies of the kettle's manufacture, not the least being the detailed craftmanship of both copper and iron workers, would not have made the utilization of these goods as trade items profitable for either Europeans or Natives. If too much was asked there would be little Native desire, but if the kettle's European value was not sought then there would be little reason to include these items.

Clearly kettles were in demand. The only alternative was to manufacture kettles more rapidly and inexpensively. This appears to have been done after GBP1 when this variety of kettle faded from the archaeological record. The worn example from GBP2 dated Grave 11 at the Grimsby cemetery is the only currently known post-GBP1 example (Figure 8). It was replaced by more rudimentary varieties, evidently geared for the fur trade market (Figure 9).

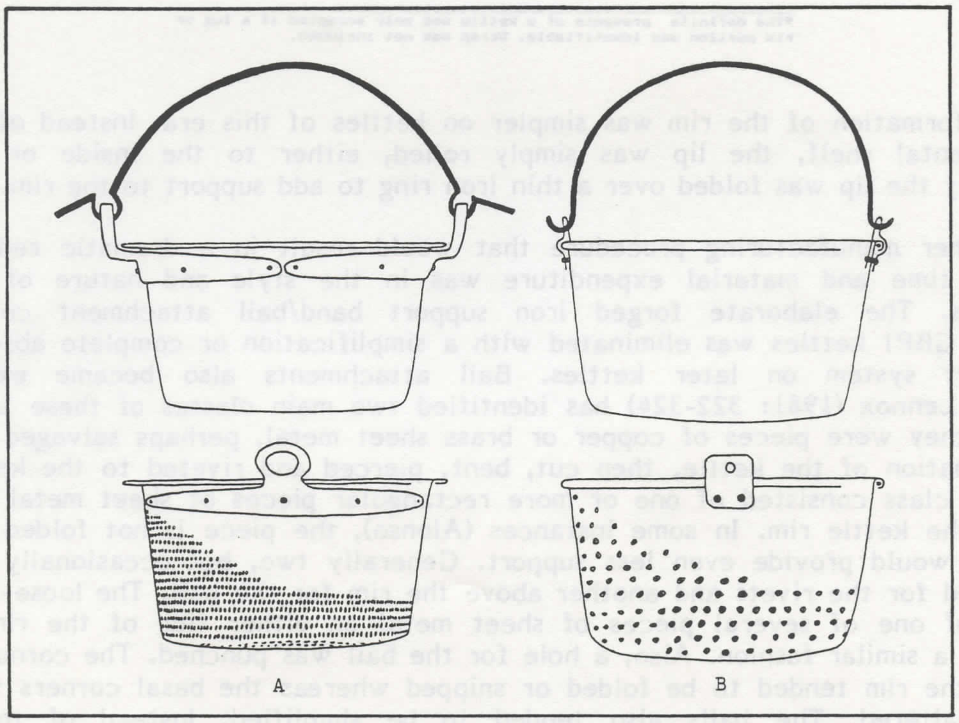

Figure 9. Morphological Comparison of GBP1 and GBP2/3 Copper Alloy Kettles.

A. GBP1 Kettle
B. GBP2/3 Kettle

Glass Bead Periods 2 and 3 Kettles

As suggested by the increase in the use of low copper content alloys, there was an attempt during this period to reduce raw material costs by decreasing the utilization of high copper content alloys (Table 3). As well, less time was spent on hammering sheets into shape, for the ball peening patterns tended to be sparse and irregular. It must be remembered, however, that these brasses could not be as readily cold-worked, so it cannot be confidently stated that this less rigourous hammering process was a result of the lower quality of the material, an attempt to reduce manufacturing time, or both. Many kettles from GBP2 and GBP3 burials commonly have the bottom of the kettles missing or separated, a feature that has often been interpreted as the ritualistic killing of the kettle. Equally plausible, the brittleness of brasses when cold-worked may have led to stress breaks at the kettle base, decreasing the life-span of the article.

TABLE 3 Raw Material Utilization for GBP2 and GBP3 Kettles.*

GBP	Site	Lugs			Rims		
		N	Copper	Brass	N	Copper	Brass
2	Warminster	9	0	100	7	0	100
	Christianson	4	75	25	8	63	37
	Alonso	1	0	100			
	Bidmead	1	0	100	1	0	100
2/3	Daniels Cem.	6	0	100			
3	Ossossane II	7	0	100	2	0	100
	Dwyer	4	0	100	4	25	75
	Hood	2	0	100			
	Walker	1	0	100	1	0	100

*The definite presence of a kettle was only accepted if a lug or rim portion was identifiable. Scrap was not included.

The formation of the rim was simpler on kettles of this era. Instead of a folded over horizontal shelf, the lip was simply rolled, either to the inside or exterior. Occasionally the lip was folded over a thin iron ring to add support to the rim.

Another manufacturing procedure that would result in a dramatic reduction in production time and material expenditure was in the style and nature of the bail attachments. The elaborate forged iron support band/bail attachment combination present on GBP1 kettles was eliminated with a simplification or complete absence of a rim support system on later kettles. Bail attachments also became exceedingly simplified. Lennox (1981: 322-324) has identified two main classes of these later lugs. Basically, they were pieces of copper or brass sheet metal, perhaps salvaged from the initial formation of the kettle, then cut, bent, pierced and riveted to the kettle. The folded-leaf class consisted of one or more rectangular pieces of sheet metal folded in half over the kettle rim. In some instances (Alonso), the piece is not folded over the rim, which would provide even less support. Generally two, but occasionally one hole was punched for the rivets and another above the rim for the bail. The loose-leaf class consisted of one of several pieces of sheet metal on either side of the rim riveted together in a similar fashion. Also, a hole for the bail was punched. The corners of the lug above the rim tended to be folded or snipped whereas the basal corners tended to be left unaltered. The bails also tended to be simplified. Instead of the forged rectangular bands, the bails from GBP2 and GBP3 sites tend to be formed from rim rods simply hooked at the ends.

Summary

The attempts to manufacture kettles at a reduced output of time and expense are quite evident. With the intensification of the fur trade, the iron-banded high copper content kettle typical of the ca. 1580-1600 era was too expensive to either manufacture or import. The decrease in the quality of workmanship and the materials used resulted in an inferior product but one that was clearly important in the trade inventory.

Iron Axes

While general differences which might permit the identification of distinct styles have been noted between iron axes, attempts to specifically correlate a variety of axe attributes with armourer's marks have not been readily productive. It has been assumed that the various marks, along with their number, each represented a category or grade of axe.

In this study, 119 complete and fragmentary axes from Neutral, Huron and Micmac sites have been used in order to isolate traits that might indicate contemporary axe grades and chronological trends in this trade commodity. In an effort to identify temporal trends, this sample has been graphically presented according to glass bead periods as provisional chronological units. It is not anticipated that iron axe styles changed as frequently as did those of glass beads; however, the sensitivity provided by this framework should reveal stylistic patterns, if any exist. As well, the elucidation of axe grades will be attempted by examining attributes without consideration of temporal placement. If clusters are evident, the categories might be related to temporal parameters.

This exercise of inductive metrology, that is, the deduction of units of measure from archaeologically recovered materials, should be assisted by implementing known 16th and 17th metrological systems. While the general lack of standardization between the various systems of measure would presumably hinder the ready definition of grades (Table 4), there are two systems that would have been utilized by manufacturers supplying goods fo the late 16th and early 17th century fur trade.

The French Systeme de Poids de Marc de Troyes was a dry weight system used between 1350 and 1840 for weighing all commodities. Its basic unit, the livre, has a metric equivalent of 489.41 grams. For linear measurement the French Ancien systeme de longeur du pied du roi - used between the 8th century and 1668 - has its pounce being equivalent to 27.22mm (Ross 1983: 76). Twelve lignes (one linge equals 2.27mm) constituted one pounce.

While the French systems and current metric equivalents will be used for graphic presentation, emphasis will be placed on the former because categories evident within the French system might be clouded when metric measurements are used. The French systems are only being used because of the assumption that the goods were at least supplied to the French, if not manufactured by them for the fur trade. If some of the goods were imported to France, other systems of measurement may have been implemented. While there was variation, the variation as not excessive. If the axes were manufactured by different foundaries using different systems there would be a degree of deviation around what might have been a standard grade. For example, a three pound/livre axe, if manufactured around 1580 in France and England, would range between 1359.24gm and 1492.99gm. While in each system the axe would be a three pound/livre product, the variation in each system would result in a current perception of dissimilarity. For that reason, instead of expecting distinct clusters with minimal variability, clusters should be evident but with significant deviation.

A number of other factors might account for blurred weight and metric categories. Even if apparently unaltered specimens are used, the orginal size and weight might be reduced by wear of the bit, several centuries of corrosion, and conservation procedures. Conceivably the initial manufacturing process could also result in deviations from prescribed standards. These axes were handwrought, produced by folding an iron strap around a mandrel, welding the two ends, forging the blade, and finally grinding,

TABLE 4. Systems of Measures for the 16th and 17th Centuries (after Ross 1983).

System	Country	When Used	Unit of Measure	Metric Equivalent (grams)
Avoir-du-pois	England	1340-1582	Pound	453.0816
Avoirdupois	England	after 1582	Pound	453.6
Hanseatic Merchants	England	pre-13th C-1582	Pound	466.56
Systeme de Marc de Troyes	France	1350-1840	Livre	489.41
Haverdepoise Merchants	England	1497-1582	Pound	497.664

TABLE 5. Armourer Marks by Glass Bead Periods.

Type	GBP1		GBP2		GBP2/3		GBP3		TOTAL
	N	%	N	%	N	%	N	%	N
3	1	11.1	6	33.3			11	25.0	18
4	1	11.1	8	44.4	1	50.0	24	54.5	34
9							1	2.3	1
12			1	5.6			1	2.3	2
7							1	2.3	1
1	4	44.4	2	11.1			2	4.5	8
8					1	50.0	1	2.3	2
11							1	2.3	1
13			1	5.6					1
5	1	11.1							1
2	2	22.2							2
6							1	2.3	1
10							1	2.3	1
TOTAL	9		18		2		44		73

TABLE 6. Axe Weight by Glass Bead Period.

GBP	N	Weight Range (gm)	Weight Average (gm)
1	16	1190-2237	1655.1
2	6	888-1710	1199.5
2/3	3	950-1355	1191.0
3	22	540-1479	1062.8

TABLE 7. Correlation Between Number of Marks and Axe Attributes.

Number of Marks	Weight (gm)			Overall Length (mm)			Bit Width (mm)		
	N	r	x	N	r	x	N	r	x
1	18	540-2109	1058.5*	29	139-222	190.4*	33	70-125	96.2*
2	1	973	973.0	2	165-200	182.5	2	95-108	101.5
3	15	1171-2237	1423.1	24	150-228	196.9	31	78-123	101.6

* If the four "odd" stamps which tend to be on heavier axes are removed, the average is dramatically reduced to 881.4. The length is reduced slightly to 185.3, and bit width to 92.9. The strongest correlation appears to be with weight.

TABLE 8. Correlation Between Number of Segments in Circular Wedge Stamps and Axe Attributes.

Number of Segments	Weight (gm)			Overall Length (mm)			Bit Width (mm)		
	N	r	x	N	r	x	N	r	x
4	24	540-1994	1140.8	38	139-222	192.3	47	70-125	97.9
5	1	647	647.0	2	157-203	180.0	3	74-100	83.3
6	1	1171	1171.0	1	168	168.0	1	84	84.0
8	2	1492-2237	1864.5	7	200-228	208.9	8	102-123	112.0

TABLE 9. Overall Axe Length by Glass Bead Period

GBP	N	r (mm)	x (mm)
1	21	175-228	210.2
2	20	185-219	205.0
2/3	10	168-219	199.8
3	44	139-222	185.1

carburizing and tempering the bit (T. Kenyon 1987). Undoubtedly, some degree of variation would result from such manufacturing techniques. Within this general variability, however, discrete clusters still should be discernable.

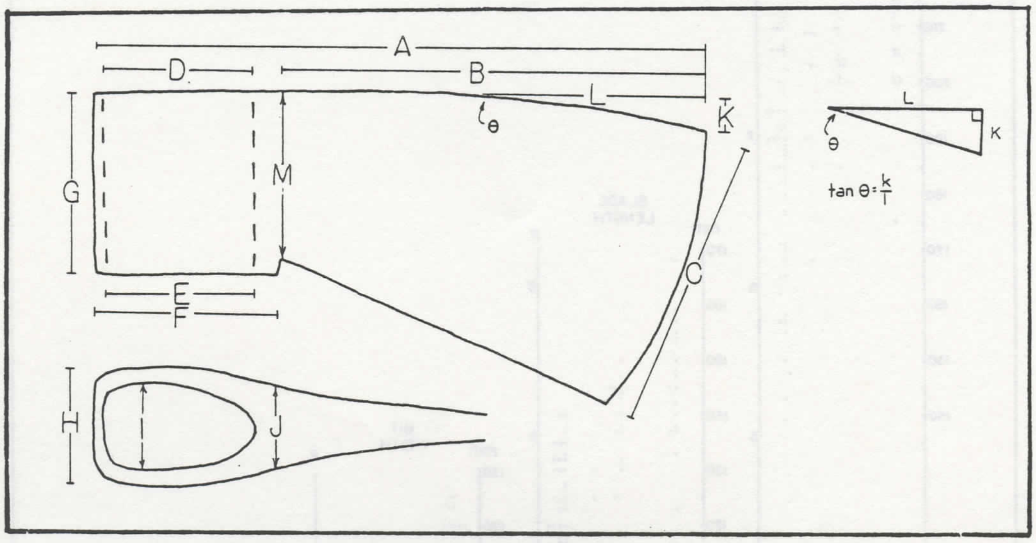

Figure 10. Iron Axe Attributes.

A. Overall length
B. Blade length
C. Bit width
D. Superior eye length
E. Inferior eye length
F. Inferior poll length
G. Poll height
H. Poll width
I. Eye width
J. Width at poll-blade transition
K. Blade drop
L. Length of drop
M. Height at poll-blade transition
θ. Angle of blade drop

While a number of measurements were taken (Figure 10), five attributes were focused upon in an attempt to identify grades of axes through correlation with armourer's marks: weight, overall length (a), blade length (b), bit width (c), and the height of the axe at the transition between the blade and the poll (m; Figure 11).

Armourer's Marks (Figure 12, Table 5)

Armourer's marks were classified according to the shape of the mark, the division of the mark, and the number and orientation of the mark. In the initial formulation of the typology, all variants were considered as separate types, however many likely represent the same type with differences in orientation and depth of mark probably being idiosyncracies of the maker rather than an indicator of a different axe style. The vast majority of the marks were circular in shape (69/73), with two diamond, one semi-circular, and another irregular.

Circular Marks: Within this class, the circle was divided primarily into a number of triangular, pie-like wedges (4, 5, 6, or 8). The four-segmented marks dominated the sample (52/69); of these, 34 were oriented diagonally (Type 4), and 18 vertically (Type 3). That orientation is not significant is suggested by the occasional presence of both orientations on the two sides of the same axe. They should thus be considered one type.

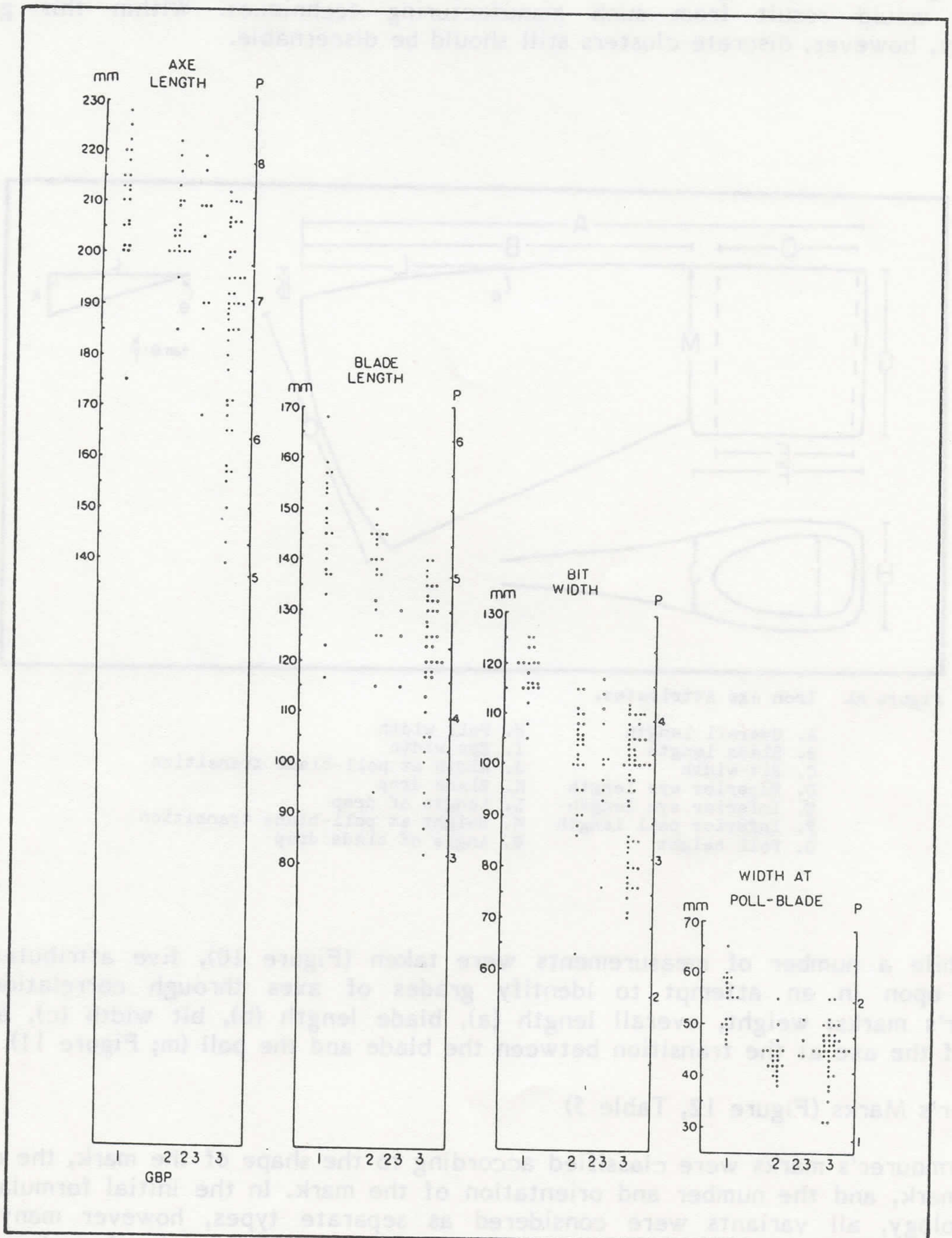

Figure 11. Distribution of Axe Attribute Metrics by Glass Bead Period.
"mm" represents "millimetres"
"p" represents "pouces"

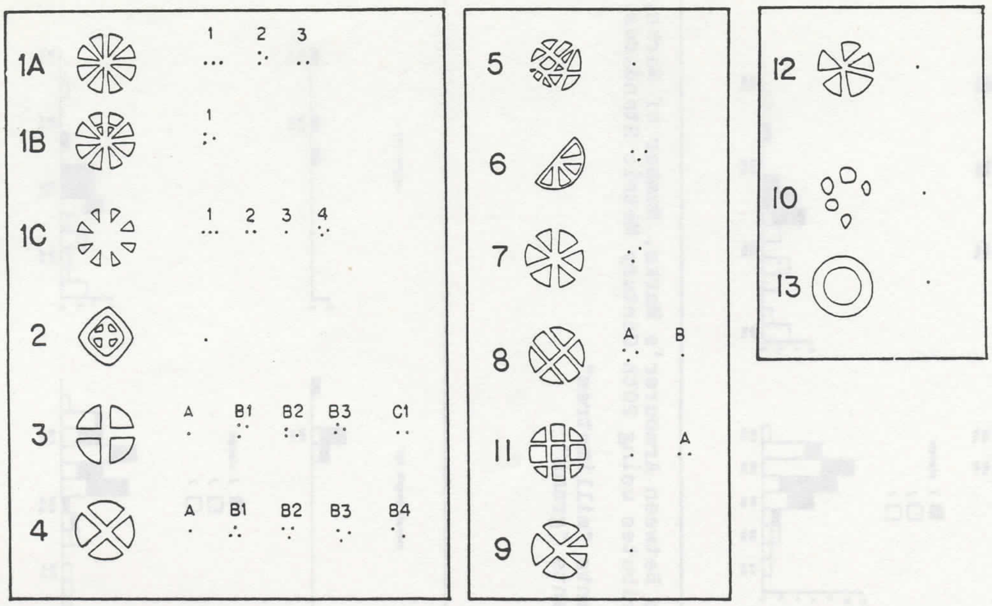

Figure 12. Iron Axe Armourer's Marks (Varieties and Configurations).

Two types of five-segmented marks were recorded. One consisted of a diagonally oriented, four segment mark with the right quadrant bisected (Type 9), and the other with four equally sized segments and a larger fifth (Type 12). Only one six segmented example has been identified (Type 7).

Eight segmented circular marks (Type 1) were the second most frequent type (8/69). The variablility exhibited within this type was noticeable between the degree of impression and also the irregularity of the distribution of wedges within the lightly impressed examples. One specimen did have a stylistic variation in that the upper two wedges were cut in half horizontally.

Another variety of circular stamp was divided into blocks, instead of wedges. The examples observed had six (Type 8) and nine (Type 11) blocks created by intersecting perpendicular lines. One circular stamp exhibited an irregular combination of wedges and blocks, perhaps the results of superimposed marks (Type 5). The last circular stamp observed differed in style in that the mark had a raised circular centre. In appearance it was to concentric circles (Type 13).

Diamond-Shaped Marks: The diamond shaped stamp (Type 2) was represented by two examples from the same site. The mark consisted of two concentric diamonds with the interior diamond divided into four right angled triangles by a vertical cross.

Semi-Circular Marks: Again, this variety (Type 6) was found only on one axe. The mark is oriented diagonally with the interior, and is divided into four raised wedges.

Irregular Marks: The one mark (Type 10) that did not readily fit into any of the categories was a specimen from the Dwyer cemetery. Conceivably, it may be considered

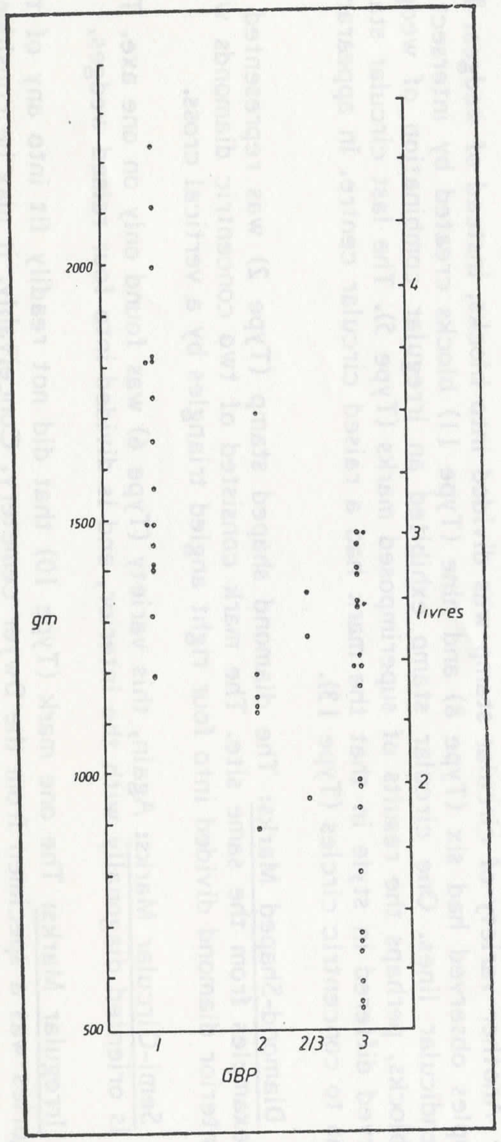

Figure 13. Distribution of Axe Weight by Glass Bead Period.

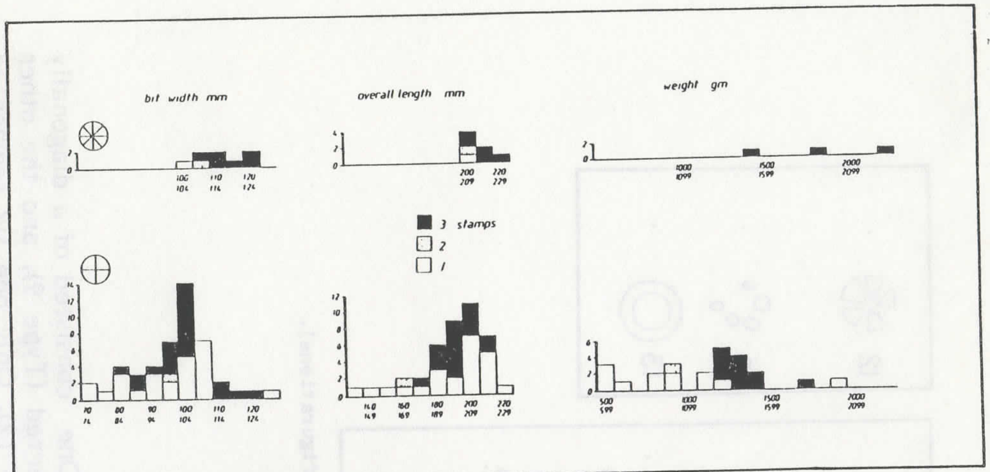

Figure 14. Relationship Between Armourer's Marks, Number of Marks, and Axe Attributes using 20th Century Metric Standards.

"mm" represents "millimetres"
"gm" represents "grams"

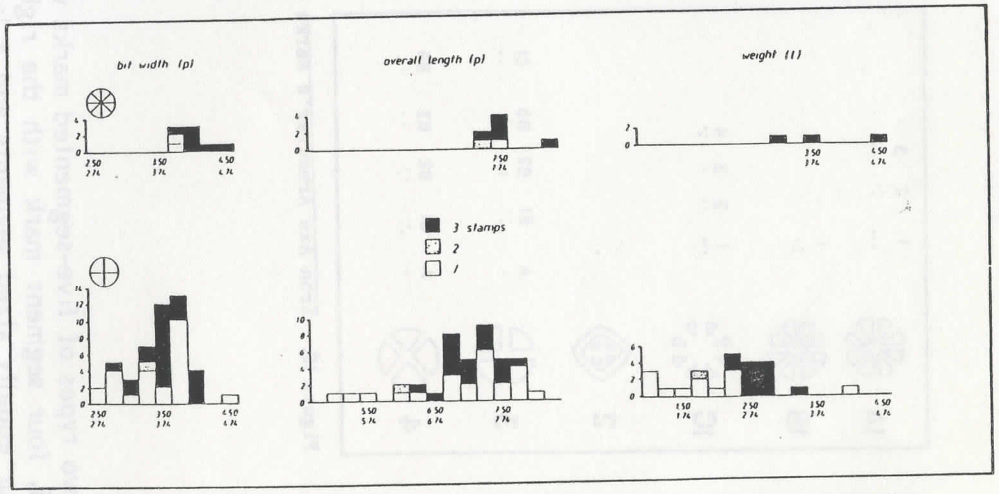

Figure 15. Relationship Between Armourer's Marks, Number of Marks, and Axe Attributes using 16th and 17th Century Metric Standards.

"p" represents "pouces"
"l" represents "livres"

a circular, five segmented wedge variant. However the mark is irregular and the wedges were irregular depressions. One depression was exterior to the general shape of the mark.

Weight

The apparent trend is for axes to become substantially lighter on sites that possess GBP2 and GBP3 glass beads (Table 6, Figure 13). Some axes recovered from GBP1 sites are as much as four times heavier than some of the smaller GBP3 axes. It is probable that this was a consequence of European cost-consciousness and economy in the inland transportation of these wares. Not only would less iron be required to manufacture smaller and lighter axes which perform the same tasks, but more axes could be imported, presumably for the same return.

When axe weights are examined without a chronological parameter, they still cluster into distinct groups despite relatively small samples. The reality of the clusters is even more credible when considering the previously mentioned factors that could determine the weight of the specimens. Within this sample five or possibly six weight classes, based on the Systeme de Poids de Marc de Troyes, are evident: 1.00-1.50 livres; 1.75-2.00 livres; 2.25-3.00 livres; 3.25-3.75 livres; and 4.00-4.50 livres. The third class could conceivably be divisible into 2.25-2.50 and 2.75-3.00 livres concentrations.

When chronological framework is re-introduced to the axe clusters, there are definite trends and correlations. Using the six weight class system, the two heaviest weight classes are restricted to GBP1 axes. The majority of axes, from all periods, fall within the two intermediary weight classes. No axes from GBP1 sites are in the two lightest classes, while the lightest category is represented exclusively by GBP3 axes.

A logical conclusion from the temporal distribution of axe weights is that once the fur trade intensified, lighter grades of axes were supplied or perhaps expressly manufactured to maximize returns. A notion that should also be entertained is that the lightest axes were not intended as felling axes but instead as belt hatchets. Perhaps the four heaviest classes (weighing more than 2.25 livres), were intended as felling and chopping axes while the axes weighing less than 2 livres were hatchets, introduced during the 1630s possibly as weapons during increasing hostilities of that period.

Overall a correlation exists between weight, armourer's mark and number of marks. The impression is that eight-segment circular marks (with one exception) are found on the heaviest axes (Figures 14-15); and for the four segment circular marks, those axes that have three impressions are the heaviest (again with one exception). Generally the trend is for the heaviest axes to be stamped with three, eight segment, circular marks, and axes with four segment circular marks are heavier if there are three stamps (Table 7).

Despite the relatively small sample size, clusters are evident among axes with four-segment circular stamps. Notable is the concentration of three impressions between 2.25 and 3.00 livres (Figure 15). The lightest axes have but one mark.

Measurements

The distribution of axe attributes by glass bead periods parallel, as would be expected, that of weight. Axes from GBP1 sites tend to be longer, clustering between 7.25 and 8.50 pounces (200 - 230mm) in length while those from GBP3 sites exhibit a notable range (5.00 - 7.75 pounces or 140 - 210mm), perhaps reflecting several size grades (Figure 11, Table 9). Axes from GBP2 and GBP2/3 sites are intermediate in size, revealing a general trend towards smaller axes.

While an overall temporal trend is evident in addition to a great range in axe length on GBP3 sites, the clustering into distinct grades is not as apparent as it was by weight. For example, with the exception of the notably short axe from the Tregunno site, the longest axe from a GBP1 site was only 14% longer than the smallest, while the heaviest axe was almost 85% heavier than the lightest. Furthermore, the length difference between axes from GBP1 sites and those from GBP3 sites is significantly less than the weight differential. The longest GBP1 axe is only 25% longer than the longest axe from a GBP3 site whereas the difference between the heaviest axes from the two periods is 50%. This clearly indicates that weight, more so than metrics, differentiates axes, since long axes can be both heavy and light. There is very little, if any, correlation between armourer's marks and metric attributes (Figures 14-15), especially among the four segment circular examples. Long axes would just as frequently have one mark as they would have three, and while the shortest axes never had three stamps, this was likely because of their extreme lightness rather than size. While there was a notable correlation between weight, variety of mark and number of marks, at least as it related to four and eight segment marks, differences for metric attributes were not similarly distinctive.

Axe Trends

It appears that the first axes introduced to Native groups were generally massive implements. Their earliest archaeological appearance is on GBP1 sites, and are included in a well-developed European trade assemblage dating to the early part of commercial fur trading. While Cartier did exchange a limited number of "hatchets" during his St. Lawrence explorations of the 1530s and 1540s, the quantities recovered from GBP1 sites (notably burials) would likely be derived from commercial, not ceremonial activities.

Commercial acumen probably accounts for subsequent trends. Axes did not become notably shorter, rather they became lighter. If a classificatory system is possible for axes it will, as this study indicates, be on the basis of weight, not length. It seems a particular weight of iron was prescribed for certain grades of axes and the size would be determined on that criterion. In an effort to conserve raw material, long axes were still produced; however iron had to be shaved from some part of the axe. After GBP1, axes tended to be laterally compressed. Whereas many axes from GBP1 sites, when examined from the superior position, reveal an essentially straight-sided configuration, those from later sites exhibit noticeable concavity, resulting in a much thinner, presumably weaker blade. Additional iron would also be saved if the height of the posterior section of the blade was reduced. The size of the bit could be preserved, but the strength of the axe at the poll-blade transition would be compromised.

The GBP1 axes were massive and presumably extremely durable items. Quite rapidly, quality decreased, which served a number of European ends: 1. less iron would be required for each axe; 2. with lighter axes more could be transported; 3. for the same amount of initial raw material investment more return would be possible; 4. inferior axes would lead to more frequent replacement.

By GBP3 there seems to have been a greater selection of weight classes which might represent a variety of activities including felling trees, timber preparation and dressing, light chopping, and possibly offensive weaponry. The variety of axes available after 1630 is likely a manifestation of the increasing availability of European goods after the appearance of the Company of One Hundred Associates.

Concluding Remarks

If nothing else is indicated from this excercise it should be that there is incredible potential for the interpretation of the archaeological manifestations of the contact era. This endeavour must not, however, be restricted to the archaeologist, and fortunately there is now developing a co-operation between many and diverse disciplines to elucidate the happenings of the 16th and 17th centuries. Element analyses of glass beads and copper alloys, examination of European notarial accounts, and a thorough knowledge of the economic events of Eurpoe are but a few of the avenues of research that will propel our understanding of the contact era beyond one of simple description. However, before this is attempted it cannot be over-emphasized the importance of having a firm chronological control. As is readily apparent (cf. Kenyon and Fitzgerald 1986), if that control is absent then cultural reconstructions will be hampered.

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